Topic: Shock acceleration of solar energetic particles by interplanetary CMEs

Project Title:
Plasma Transport from The Solar Wind to the Magnetosphere

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Project Information:
The mechanism by which the solar wind plasma enters the magnetosphere remains an important and to a large degree unanswered question. A number of mechanisms have been proposed for this process. For example, there is direct entry along newly reconnected field lines, there is diffusive entry (perhaps drift mediated) along the magnetopause, there is impulsive penetration, to name a few. What does seem clear is that the amount of plasma within the magnetosphere is correlated with the density in the solar wind. This question of plasma entry has been called out in the current NRA as an important science question of interest to the NASA Sun-Earth Connection Program.

We will attempt to determine the processes by which entry, energization and energy extraction take place through a number simulation codes, used singly and in concert. The simulation codes are: 1. A global MHD magnetospheric code which has been used successfully to model many of the aspects of magnetospheric structure and dynamics. This will be the workhorse for this project. It can be used to track fluid elements from, say, positions in the plasma sheet to their origins in the solar wind. 2. A particle tracking code that integrates the Lorentz orbits of particles within the system. In conjunction with the fields from the global MHD code, it can give ihe currentsnformation about the actual trajectories of the particles making up the collisionless plasma. 3. Two fluid and hybrid codes to model

the boundary layers (magnetopause) of the global system. One of the deficiencies of the MHD codes is that the boundary layers are both not resolved and deficient in physics. This makes the results of tracing particle trajectories through such layers problematic.

Our approach will be two-fold. On one track we will use the global MHD model to set up idealized situations where the plasma enetry can be studied using the full array of tools listed above. Typically, then the MHD code would provide a base time-dependent configuration of electric and magnetic fields, as well as fluid flows. The results for plasma entry for the fluid model will then be compared against the results for the particle tracing. The kinetic codes will be used in conjunction with the particle tracing to develop ideas about the actual rates of particle penetration and reflection and energy gain or loss through the boundary layer.

In the second track, we will try to validate the models by reference to actual data. This is generally easier with the MHD models than with the other simulations. Here we will rely on a combination of single event studies and upon statistical studies.

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